

Three major fields in mathematics essay sample

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The three different theories and fields which were discussed in this paper are the Chaos theory, Topology and Game Theory. Important ideas, people and connection among the three areas of mathematics are also discussed in this paper.

Chaos theory studies the behavior of dynamic systems which depends sensitively on its initial conditions (Strevens, n. d.). Little differences in initial conditions result to an extensively different outcomes for chaotic systems, depicting long-term forecast to be impossible. This occurs even though these systems are deterministic, meaning that their future performance is completely determined by their initial conditions, with no random factors involved (Kellert, 1993). Therefore, the deterministic nature of these systems cannot make them predictable (Werndl, 2009). An early proponent of chaos theory was Henri Poincaré. In 1890, Henri Poincaré explained that three body systems (Newtonian gravitational theory.) can undergo chaos in a modern sense and discovered that there can be orbits which are non-periodic but not increasing nor approaching a fixed point (Poincaré, 1890). He concluded that a systematic treatment of three body dynamics would be very difficult or nearly impossible (Strevens, n. d.). Another early proponent of the theory was Edward Lorenz whose curiosity in chaos came about by accident during his work on weather prediction in 1961 (Lorenz, 1963). Lorenz's discovery showed that even specific atmospheric modeling cannot formulate long-term weather predictions. Weather is generally predictable about a week ahead.

Topology, as a branch of mathematics, is defined as " the study of qualitative characteristics of certain entities that are invariant under certain type of

changes, especially those characteristics that are invariant under a certain type of uniformity." In simple terms, topology is the study of continuity, connectivity and most commonly known as "rubber geometry" (Aull & Lowen, 2001; James, 1999). The word topology is used for a unit of sets with certain characteristics that are used to describe a topological space. Of particular importance are homeomorphisms, which can be described as continuous functions with a continuous inverse. An early proponent of this field is Leonhard Euler who stated that it is impossible to locate a route in the town of Königsberg that would traverse each of its seven bridges just once. The answer solely depends on connectivity properties like which bridges are connected to which islands or rivers. There are many proponents for this mathematical field but the main proponent who paved way to other works regarding topology is none other than Henri Poincaré. Henri Poincaré published *Analysis Situs* in 1895, establishing the ideas of homotopy and homology, which are now considered as part of algebraic topology (Poincaré, 1895).

Game theory is a branch of applied mathematics and economics that studies strategic conditions where there are numerous stakeholders, each with different purposes, whose acts can influence one another (Open Options, 2007). Classic uses contain sense of balance in several games, where each individual has found an approach that cannot effectively improved his results, given the further approach. The book *The Theory of Games and Economic Behavior* by John von Neumann and Oskar Morgenstern is typically recognized as the foundation of the game theory. This founding work focused on discovering exceptional strategies which permitted players to

minimize their maximum losses (minimax solution) by considering, for each potential strategy of their own, all the possible reactions of other players (von Neumann & Morgenstern, 1944). This strategy was first developed in economics to extensively study economic behaviors and then applications of game theory expanded to other social sciences like politics, sociology, and psychology.

Even though these mathematical fields contribute to other fields of sciences, the theories also contribute in explaining concepts and problems among the theories. An example is that under certain situations, the topological analysis will provide assistance in creating the existence and properties of the balance of a game. Through the property of topology, certain games have “Nash equilibrium” only if they are unfair in the sense that games can be manipulated by one player more than by others (Chichilnisky, 1983).

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